FARMERS' BULLETIN 1145
UNITED STATES DEPARTMENT OF AGRICULTURE

# Handling and Transportation of CANTALOUPES

FULLY 10 per cent of the cantaloupes produced in the Western States reach the consumer so green that they are practically worthless for food.

The carrying and keeping qualities are directly dependent upon the care exercised in harvesting and preparing for market.

Cantaloupes for long-distance shipment should be picked just before the full-slip state of maturity.

After picking, cantaloupes should be loaded as soon as possible into iced refrigerator cars for shipment.

Cantaloupes should preferably not be wrapped. They do not refrigerate so well in transit nor do they reach the consumer in as good condition as unwrapped cantaloupes.

Loading different styles of packages together obstructs air circulation and seriously retards refrigeration.

Floor racks are an efficient aid in the refrigeration of cantaloupe shipments. In cars equipped with floor racks and basket bunkers, salt may be effectively employed to hasten refrigeration.

The ability of refrigerator cars to cool cantaloupe shipments quickly and to maintain desirable temperatures in transit depends directly upon proper bunker and bulkhead construction and upon the quantity and quality of the insulating material used.

This bulletin is a revision of Markets Document 9, "More Care is Needed in Handling Western Cantaloupes," and Markets Document 10, "Loading and Transporting Western Cantaloupes."

Contribution from the Bureau of Markets.
GEORGE LIVINGSTON, Chief.
Washington, D. C. May, 1921.

# THE HANDLING AND TRANSPORTATION OF CANTALOUPES.

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## COMMERCIAL CANTALOUPES TRAVEL LONG DISTANCES.

ABOUT four-fifths of the 21,402 cars of cantaloupes shipped in the United States in 1920 originated in the States of Colorado, New Mexico, Arizona, Nevada, and California. The larger part of these cantaloupes found their way to middle western and eastern markets—a journey requiring anywhere from 6 to 12 days. Those that were properly picked and carefully handled delighted the consumers with their rich color and delicious flavor. A large number, however, were picked so immature that even in distant markets consumers found them green and tasteless.

Green melons have a depressing effect on both demand and prices. If 1 per cent of the annual production of the Western States were picked and shipped unripe, buyers would purchase more than 40,000 crates of cantaloupes practically worthless for food. Instead of only 1 per cent, fully 10 per cent are so immature when placed upon the market that they are not palatable nor even of fair eating quality. It is little wonder that many householders are unwilling to buy fruit of such doubtful quality.

During three recent shipping seasons the Department of Agriculture conducted investigations[1] in the western producing sections and chief eastern consuming centers in order to determine the most satisfactory methods for handling cantaloupes for long-distance shipment. Several test trips were made. Some of the more important results of these investigations which may be of benefit to growers and shippers are presented in this bulletin. While the studies were

[1] The methods used in these investigations are outlined on page 23

confined to certain areas, the fundamental principles in regard to maturity at time of picking, careful packing, prompt shipment, and thorough refrigeration are directly applicable to the handling of cantaloupes wherever grown and to any shipments which are three days or longer in transit.

## PICKING JUST BEFORE FULL SLIP INSURES BEST QUALITIES.

While it is necessary that cantaloupes be picked before they are entirely ripe in order to provide the essential keeping quality in transit, they may be picked at a stage of maturity that will afford good flavor as well as keeping quality. To insure the best eating quality when they reach consumers, cantaloupes should be picked just after they will slip cleanly from the stem; that is, at the full-slip stage of maturity. If properly handled and promptly loaded they will carry in satisfactory condition even to distant markets. Allowance must be made, however, for a certain amount of rough handling and for some delay in transit. As a general rule, therefore, cantaloupes should be picked just before they reach the full-slip stage. Such melons possess not only the desirable eating quality but also the necessary carrying quality.

If cantaloupes are to be in transit 10 days or more, it is advisable to pick them just before they reach the full-slip stage of maturity. This conclusion is based on inspections of comparative shipments of Pollock cantaloupes from the Imperial Valley and Turlock districts of California to New York City during the seasons of 1916 and 1917. Table 1 gives the average results of inspections of 29 shipments.

TABLE 1.—*Condition of cantaloupes in New York City, on unloading from refrigerator cars, and two days later, season of 1917, as shown by inspection.*

| Condition of melons. | On unloading. | | | Two days later. | | |
|---|---|---|---|---|---|---|
| | Picked full slip. | Picked just before full slip. | Picked commercially. | Picked full slip. | Picked just before full slip. | Picked commercially. |
| | *Per cent.* | *Per cent.* | *Per cent* | *Per cent.* | *Per cent.* | *Per cent.* |
| Too soft to be desirable | 12.7 | 9.7 | 13.4 | 17.7 | 1.6 | 20.7 |
| Too yellow, overripe | 11.5 | 2.2 | 6.1 | 27.0 | 10.7 | 14.9 |
| Decayed enough to spoil for food | .1 | . | .3 | 3.1 | 1.1 | 5.1 |
| Meat "cukie" or of tough immature texture | [1] | [1] | [1] | 3.5 | 1.1 | 1.4 |
| Meat too ripe to be desirable | [1] | [1] | [1] | .1 | 1.9 | 13.9 |

[1] Not recorded.

## CAREFUL HANDLING PREVENTS BRUISING AND DECAY.

The carrying and keeping qualities of cantaloupes are directly dependent on the care exercised to prevent mechanical injuries in harvesting and preparation for shipment. The present commercial handling practices are unnecessarily rough and are responsible for a large

amount of decay and spoilage in transit and after arrival at market. These conclusions are based on inspections of comparative shipments of Pollock cantaloupes from the Imperial Valley and Turlock districts, Calif., to New York City during the seasons of 1916 and 1917. Table 2 gives the average results of 20 experimental shipments from Turlock, Calif.

TABLE 2.—*Deterioration found in 20 experimental shipments of carefully handled and commercially handled cantaloupes, on unloading from refrigerator cars in New York City, and two days later, season of 1917.*

| Condition of melons. | On unloading. | | Two days later. | |
|---|---|---|---|---|
| | Carefully handled. | Commercially handled. | Carefully handled. | Commercially handled. |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Decayed enough to spoil for food | 0.0 | 0.5 | 0.4 | 6.0 |
| Molded enough to affect appearance | .5 | 2.4 | 3.5 | 9.2 |
| Spoiled for food by bruising only | (1) | (1) | 3.5 | 11.7 |

[1] Not recorded.

From the standpoint of minimizing bruising or other mechanical injury many faults in present handling practices may be corrected readily by reasonable attention to equipment and labor. The regulation lemon or orange picking bags made of fairly heavy canvas and equipped with shoulder straps are preferable to the burlap or grain sacks commonly used. Sacks without shoulder straps are constantly being raised and lowered and dragged over the ground by the pickers. A large percentage of commercially handled cantaloupes is bruised in this manner. Bags with shoulder straps leave the hands of the pickers free, and the openings at the bottoms permit the bags to be lowered into the crates and so lifted that the melons will roll out gently.

No cantaloupes should project above the upper edges of the field crates. If this precaution is neglected, the top crates when loaded on the field wagon rest on the projecting melons in the crates below, and serious bruising inevitably occurs.

When unloaded from field wagons, crates should be stacked with care to avoid dropping or other jarring. Cantaloupes from field crates should be graded or emptied carefully into packing bins without unnecessary throwing, dropping, or rolling. The lining of packing bins should be made of soft material, or, if made of boards, should be well padded to prevent bruising.

During the operation of packing, cataloupes should be placed carefully in the crates and not dropped or tossed into place, as is frequently done. Injury caused by squeezing can be prevented if packers are careful not to force in oversized melons when finishing crates.

Cantaloupes should be packed so that the tops of the crates bulge slightly when cover slats are nailed on. If the tops bulge too much, the cantaloupes become squeezed and bruised, and spoilage results.

Packed crates require just as careful handling as do individual melons prior to packing. They should be stacked only on their sides, as the side bulge is usually much less than that of the top and there is thus less chance of injuring the cantaloupes. Wagons used for conveying packed crates to car-loading platforms should be equipped with springs to reduce injury from jarring.

The greatest care should be exercised in stacking packed crates, in stowing them in cars, and in loading them on and off wagons. It frequently happens, through accident or carelessness, that packed crates are thrown or dropped into position. It is hardly necessary to call attention to the serious injury and deterioration resulting from such carelessness. This applies with equal force to the handling which crates receive during unloading from cars and during distribution to wholesale, jobbing and retail stores.

#### PROMPT LOADING INTO REFRIGERATOR CARS REDUCES LOSSES.

The reduction of serious market losses from oversoft, overripe, and decayed cantaloupes is dependent to a large extent upon the prompt-

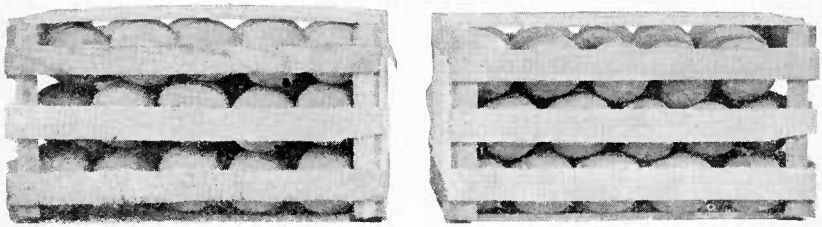


FIG. 1.—Immediate versus delayed loading of cantaloupes. Note the greater shrinkage in the crate on the right as compared with the crate on the left. The crate on the right was not placed under refrigeration until 24 hours after the melons were picked, while the crate on the left was loaded three hours after picking. This photograph was taken two days after they were unloaded at destination.

ness with which they are placed under refrigeration. After picking, cantaloupes should be hauled without delay from the field to the packing shed, where they should be kept in the shade until packed. They should be packed immediately, and while being hauled from the packing shed to the car-loading platform, should be covered with canvas or other light-colored cloth to protect them from the sun. As soon as possible after packing, cantaloupes should be loaded into iced refrigerator cars for shipment. The importance of this promptness is illustrated in figure 1.

The inspection data of experimental shipments of Pollock cantaloupes from the Imperial Valley to New York City during the seasons of 1916 and 1917 also strongly emphasize this factor. Table 3 gives

the average results of inspections of 13 shipments of comparative lots delayed one, four, and eight hours before loading during the season of 1917.

TABLE 3.—*Condition of cantaloupes held 1 hour, 4 hours, and 8 hours at shipping point before loading into refrigerator cars, on unloading in New York City, and two days later, season of 1917, as shown by inspection.*

| Condition of melons. | On unloading. | | | Two days later. | | |
|---|---|---|---|---|---|---|
| | 1 hour. | 4 hours. | 8 hours. | 1 hour. | 4 hours. | 8 hours. |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Too soft to be desirable | 8.4 | 16.7 | 27.0 | 30.6 | 34.7 | 43.2 |
| Too yellow—overripe | 8.4 | 13.3 | 15.0 | 20.9 | 21.5 | 26.3 |
| Decayed enough to spoil for food | ..... | ..... | 1.2 | 2.9 | 3.3 | 4.4 |

## WRAPPING PROMOTES THE DEVELOPMENT OF MOLD.

Wrapped cantaloupes do not refrigerate so well in transit and do not reach consumers in as good condition as do unwrapped cantaloupes. These conclusions are based on inspections of comparative shipments of Pollock cantaloupes from the Imperial Valley, California, to New York City during the seasons of 1916 and 1917. Table 4 gives the average results of 13 shipments.

TABLE 4.—*Condition of 13 experimental shipments of wrapped and unwrapped cantaloupes in New York City, on unloading and two days later, season of 1917, as shown by inspection.*

| Condition of melons. | On unloading. | | Two days later. | |
|---|---|---|---|---|
| | Wrapped. | Unwrapped. | Wrapped. | Unwrapped. |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Too soft to be desirable | 17.7 | 15.3 | 28.8 | 34.0 |
| Too yellow—overripe | 8.7 | 4.6 | 17.7 | 2.7 |
| Decayed enough to spoil for food | .5 | .0 | 22.7 | 4.6 |
| Molded enough to affect appearance | 3.1 | .2 | 42.4 | 2.7 |

Two days after cantaloupes involved in these studies were unloaded from refrigerator cars at the markets, the wrapped melons were slightly firmer than the unwrapped, because the wrappers retarded to some extent the evaporation of moisture. The difference, however, is so slight that it does not compensate for the increase in decay and mold which wrapping causes.

Free circulation of cold air around each crate and around each melon is essential to quick, effective refrigeration in transit Wrapped cantaloupes cool more slowly than those not wrapped because the paper retards the free circulation of cold air and acts to some extent as an insulator, preventing the free transmission of heat from the melons.

Figure 2 presents the average of the top and bottom layer temperatures of two cars of similar construction, loaded similarly, with the exception that the melons in one were wrapped and those in the other were not wrapped. The differences shown are representative of the retardation of refrigeration which may be expected when cantaloupes are wrapped for shipment.

It is not advisable to wrap cantaloupes, even though it is impossible to load them immediately after packing. A comparison of

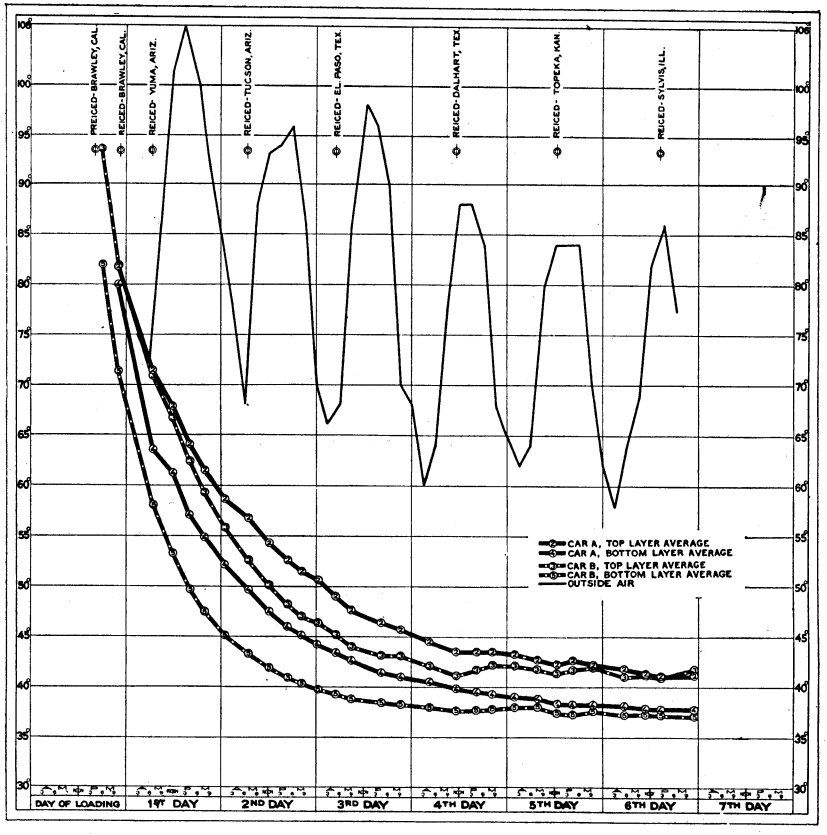



FIG. 2.—Diagram illustrating the effect of wrapping cantaloupes upon temperatures in transit. The melons in car A were wrapped; those in car B were not wrapped. These cars were in transit from Brawley, Calif., to Chicago, Ill., June 19 to 25, 1916.

the data in Tables 3 and 4 shows that two days after unloading from refrigerator cars the loss resulting from delay in loading is much less than the loss from wrapping. This loss would naturally occur in any wrapped cantaloupes, whether they were loaded for shipment immediately after packing or whether they were held in the open for a considerable time before loading, because the loss from wrapping occurs after the cantaloupes are unloaded from refrigerator cars at centers of consumption.

Most of the loss from wrapping occurs because of decay and mold which develop after cantaloupes are unloaded from refrigerator cars at centers of consumption. When, on summer days, crates of cold cantaloupes are removed from refrigerator cars, moisture from the atmosphere condenses on the surface of the melons. This moisture soon evaporates from unwrapped cantaloupes, but from wrapped cantaloupes the evaporation is hindered by the paper, which tends to retain the condensed moisture. This retained moisture acts as a medium favorable to the growth of organisms which cause the development of decay and mold, as illustrated in figure 3.

Aside from causing losses through decay and mold, the practice of wrapping is undesirable because it enables unscrupulous persons to cover and pack defective cantaloupes which, if not wrapped, would be thrown out. Both in producing sections and at centers

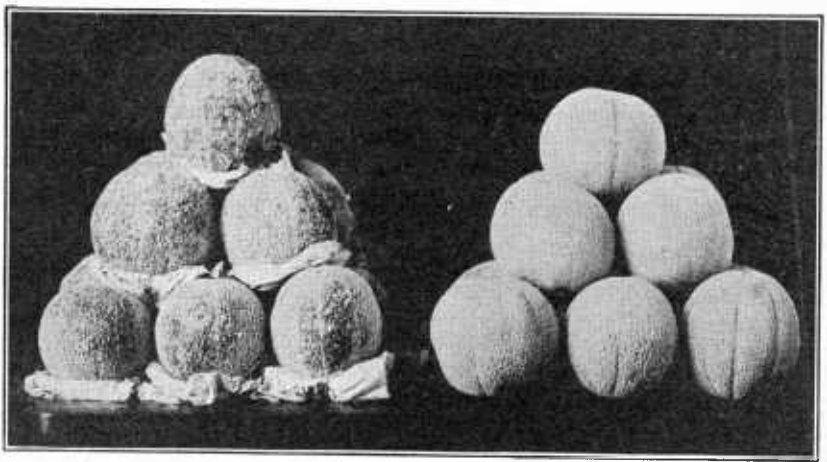


FIG. 3.—Wrapped versus not wrapped cantaloupes. Those on the left were wrapped, those on the right were not wrapped. This photograph illustrates their condition two days after unloading from a refrigerator car. Note the mold on those melons which were wrapped.

of consumption, inspectors and buyers find it more difficult to examine crates of wrapped melons.

## MIXED LOADING OBSTRUCTS REFRIGERATION.

The method of loading employed and the care taken to secure a uniformly spaced load are factors of great importance in influencing the refrigeration of cantaloupes in transit which are under the direct control of the shipper. One of the greatest obstacles to rapid and uniform refrigeration is the common practice of mixing different styles of packages in the same load. The circulation of cold air from the ice bunkers through the load is necessarily slow even under the best conditions, and if open spaces between the rows of packages are not provided, the flow of cold air toward the center of the car is still further checked. Under these conditions the cold air

from the ice bunkers rises toward the ceiling of the car, and returns to the bunker without completing its normal circuit, and consequently refrigeration of the crates in the center of the car is retarded materially.

Although mixed loading is the most common cause of these air blockades, careless loading or shifting of packages will bring about the same unfavorable condition. Every effort should be made to load only one style of package in the same end of a car. If it should be necessary to load flats and standard crates together, the flats should be placed on top layers or in the stacks nearest the bracing.

The practice of opening either the front or rear ventilators of a refrigerator car during the first night the car is in transit has some adherents among cantaloupe shippers. Some of them think that cantaloupes arrive at market in a firmer condition and that fewer yellow melons develop when the ventilators are so opened. A few tests of the value of this practice have been made, but the results obtained are inconclusive. It can be definitely stated that refrigeration is not hastened by this practice; on the other hand, the admission of outside air during the night does not seem to raise the cantaloupe temperatures or retard refrigeration. An average of 400 or 500 additional pounds of ice is melted in each car when the ventilators are open.

### TEMPERATURES VARY IN DIFFERENT PARTS OF THE SAME LOAD.

Figure 4 shows the temperatures secured in four cars of cantaloupes, which were included in a test trip from Brawley, Calif., in 1916. Two of these cars were loaded 7 crates wide and 3 high throughout. The other two were loaded 6 crates wide and 4 high, for a distance of 4 stacks from each bulkhead. The remainder of the load was 3 crates high.

The temperature records, which have been confirmed by later tests, show that cantaloupes 4 crates high can not be cooled satisfactorily in the ordinary refrigerator car. It will be noted that the average temperature of the top layer crates at the bulkhead in cars loaded 6 wide and 4 high is higher than the top layer temperature in the center of the cars loaded 7 wide and 3 high, and considerably higher than the top layer temperature at the bulkhead of these cars. The average temperature at the center of the cars loaded 6 crates wide was lower than the temperatures against the bulkhead, owing to the fact that the melons were only 3 crates high at this point. It corresponded almost exactly to the average top layer temperature at the center of the cars loaded 7 wide, and for that reason has not been included in the diagram.

Figures 5 to 10 illustrate graphically the temperatures in transit secured in cars of cantaloupes, when the cars vary in construction

and in the refrigeration methods employed. The six temperatures shown on each chart are those which are approximately representative of conditions throughout the whole load. They were secured in crates located in the top layer at the bulkhead, the bottom layer at the bulkhead, the top layer half way between the bulkhead and door frame, the bottom layer halfway between the bulkhead and door

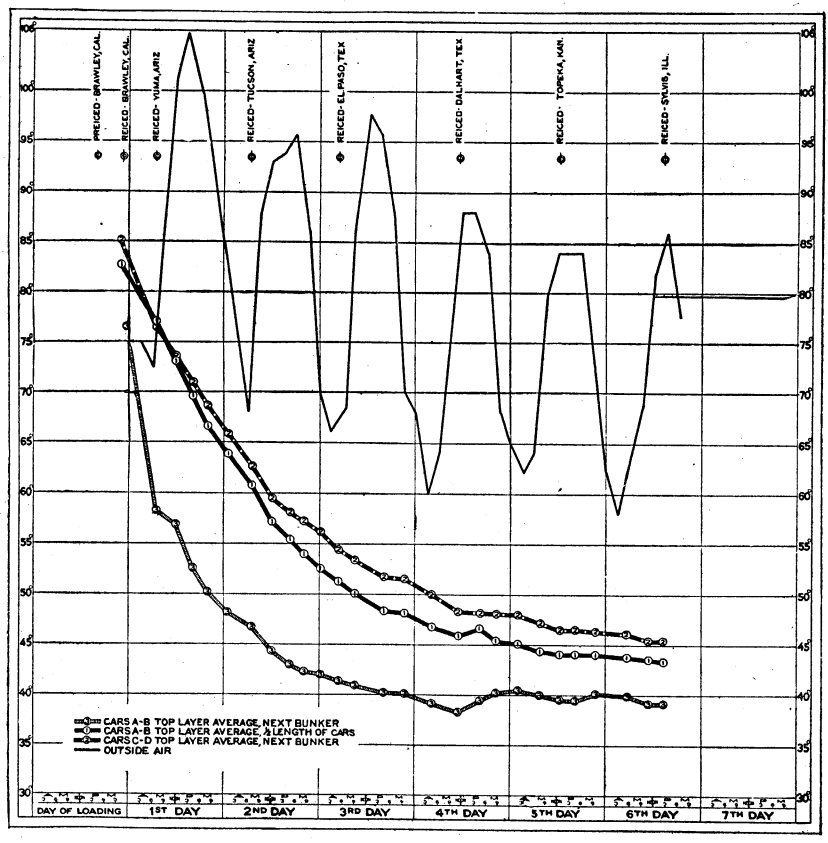



FIG. 4.—Diagram showing top layer temperatures at the bulkhead and adjacent to the bracing in cantaloupe shipments. Each curve represents the average of two cars. Cars A and B were loaded 7 crates wide and 3 crates high throughout; cars C and D were loaded 6 crates wide throughout and 4 crates high in the 4 stacks next to each bulkhead. These cars were in transit from Brawley, Calif., to Chicago, Ill., June 19 to 25, 1916.

frame, the top layer next to the bracing, and the bottom layer next to the bracing. It will be noted that the temperatures in these six positions vary considerably.

### FLOOR RACKS ARE AN AID TO UNIFORM REFRIGERATION.

Slatted false floors, or floor racks, have proved to be a most effective aid to refrigeration, and have been included as part of the equipment of nearly all refrigerator cars constructed since 1916. As

permanently constructed, the floor racks are hinged to the car walls, and may be raised when the car is cleaned. The cross-slats are about 4 inches wide, and are sufficiently close together to permit trucking over the racks. The lengthwise stringers are 4 inches high, providing a clear 4-inch air space under the entire load.

Figure 5 presents graphically the temperatures in an ordinary refrigerator car, loaded 7 crates wide and 3 high, shipped from Brawley, Calif., to New York City in June, 1917. Figure 7 shows the temperatures in a car equipped with solid insulated bunker bulkheads and floor racks, shipped from Brawley, Calif., to New York City at the same time. It will be noted that refrigeration is more uniform in the car with floor racks and that cooling proceeds more rapidly. This fact is very noticeable in the temperatures of the top layer crates, especially the one located near the doorway. Other tests have demonstrated that the temperatures shown in these diagrams are representative of the conditions obtained in cars of these two types. The additional cooling obtained by the use of floor racks is an important factor in retarding ripening and deterioration. The reduction of the temperatures of the top layer is now the chief problem in transit refrigeration.

### SUCCESSFUL INSULATION DEPENDS UPON CAR CONSTRUCTION.

The bunker and bulkhead construction of refrigerator cars has an important effect on the refrigeration obtained in transit. In the ordinary box bunker air circulation is obstructed by the mass of ice, and refrigeration of the shipment is retarded in consequence. To overcome this difficulty, it has been found desirable to attach heavy wire screens, or perforated metal sheets, to 2-inch vertical nailing strips, which are secured to the sides and ends of the bunker. This so-called "basket bunker" provides a clear 2-inch air space on all sides of the ice. The advantages of this space may be clearly seen.

A solid, insulated bunker bulkhead with 12 to 14 inch openings at the top and bottom has been found more effective than the open type of bulkhead, when used with the wire-basket bunker and floor racks. With a bulkhead of this type, the air must pass to the bottom of the bunker and be completely chilled before it escapes to the body of the car. In cars equipped with open bulkheads, many local currents of partially chilled air pass through the bulkheads at various points.

The ability of refrigerator cars to refrigerate cantaloupe shipments and to maintain satisfactory temperatures in transit depends, also, upon the quality and quantity of insulating material employed in their construction. Tests have shown that the minimum requirements for the floors of refrigerator cars are 2 inches of cork, protected

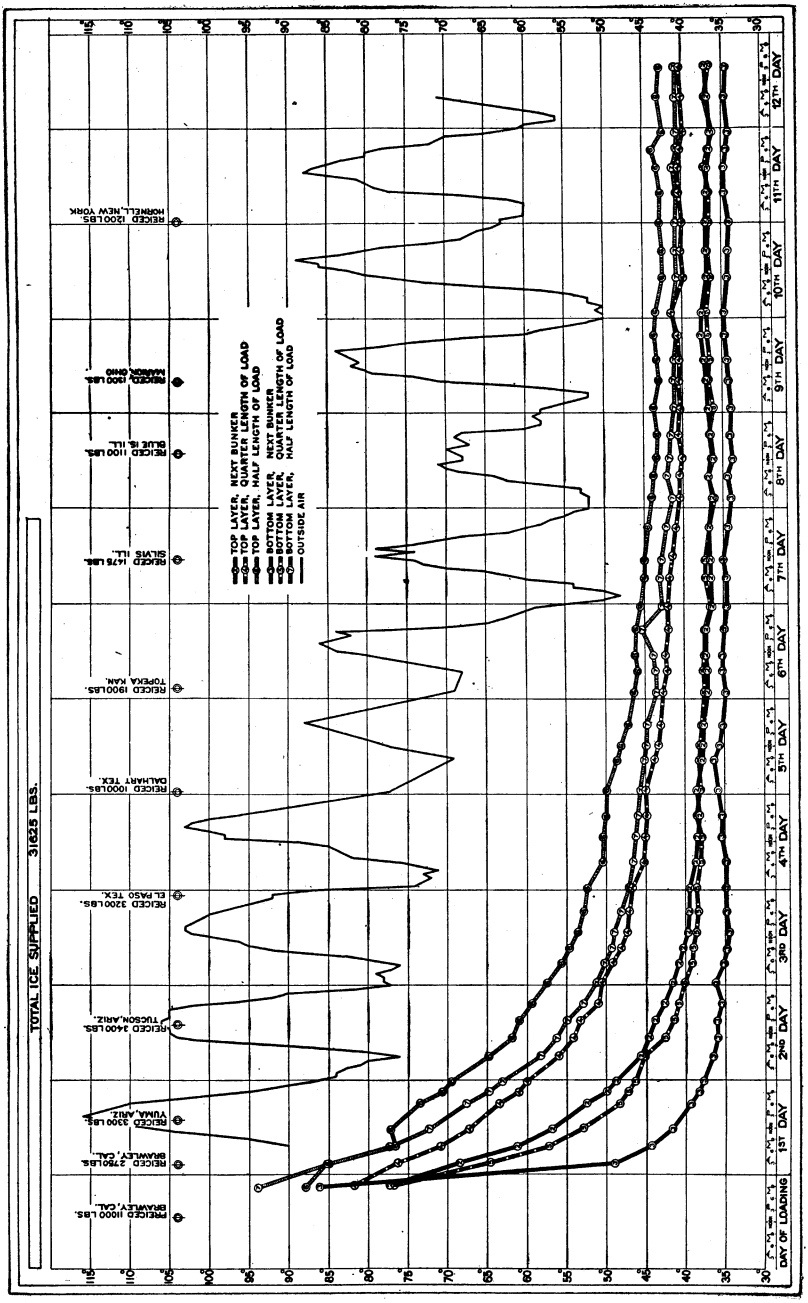



FIG. 5.—Diagram showing cantaloupe temperatures in a car equipped with open bulkheads and not equipped with floor racks. This car was in transit from Brawley, Calif., to New York, N. Y., June 26 to July 8, 1917.

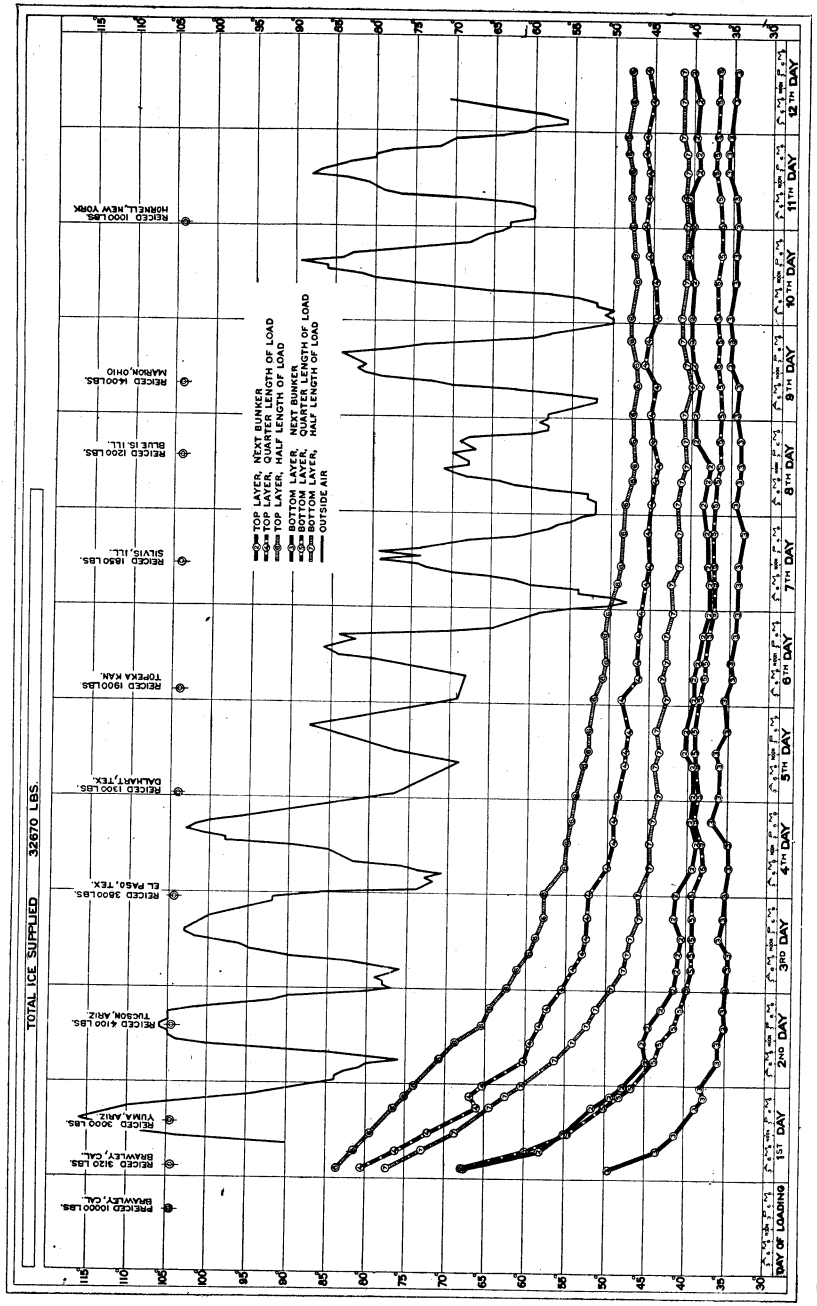



FIG. 6.—Diagram showing cantaloupe temperatures in a car similar in quantity of insulation to the car represented in figure 5, but of poorer construction and in poorer repair. This car was in transit from Brawley, Calif., to New York, N. Y., June 26 to July 8, 1917.

from moisture by waterproof paper, or other waterproofing material. For the walls, 2 inches of cork, or material which is equivalent to cork in heat transmission, are necessary, and for the roof 2½ inches of insulating material, equivalent in heat transmission to 2½ inches of cork. Equally as important as the amount and quality of insulating material employed is the method of its application to the car walls, and the attention paid to details in the construction, rebuilding or repairing of the cars.

The importance of these factors is illustrated by figure 6, which shows diagrammatically the temperatures obtained in a car of cantaloupes shipped from Brawley to New York City in June, 1917. This car may be compared with the car represented in figure 5. It contained an equal quantity of insulating material but was not of equally good construction, nor had it been so carefully inspected, or repaired, when repairs were necessary. The temperature differences are striking and illustrate the importance of close attention to details of construction and repair of refrigerator cars. An average of the top layer temperatures in these two cars is shown in figure 8.

The two upper curves in figure 9 represent the top layer temperature next to the bracing in the same cars. Attention is called to the heavy black lines in figure 9 representing the percentage of soft cantaloupes in the top layer of each of these cars when inspected at New York. Car A, it will be seen, arrived with 86 per cent soft, or all crates except those immediately against the two bulkheads. In Car B, 14.3 per cent of the melons in the top layer were soft.

## SALT HASTENS REFRIGERATION.

The refrigeration of perishable shipments is effected by the melting of ice in the bunkers of the cars. If no ice is melted no cooling results. The rather common belief that the presence of ice in itself constitutes a source of refrigeration is not correct. The actual condition is comparable to the burning of coal to produce heat. It is the burning coal which produces heat; the mere presence of coal can not affect temperature conditions.

After the ice is melted, the resulting cold water has very little cooling effect in comparison with that of the ice in melting. One pound of ice will take up 144 heat units during the melting process, whereas the pound of water formed from the same ice will take up only 1 heat unit for each degree which it is warmed.

Ice made from pure water melts at exactly 32° Fahrenheit. When ice is melting in contact with air, its temperature must be 32°. If it were colder it would not be melting. It can not become warmer until after it is melted. When, however, salt is mixed with crushed ice, a mixture is formed which melts at a temperature lower than 32°. The temperature at which it melts depends on the percentage

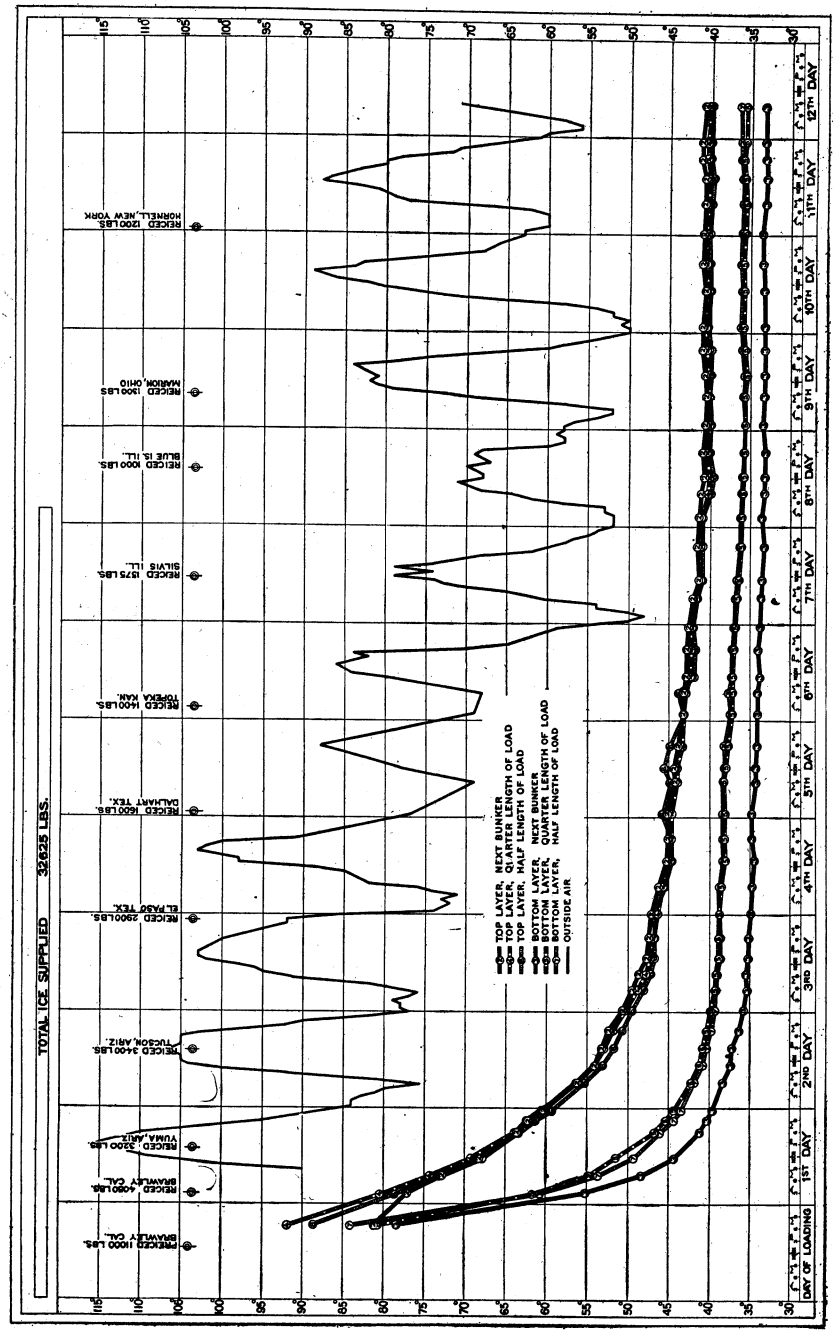



FIG. 7.—Diagram showing cantaloupe temperatures in a car equipped with basket bunkers, insulated bulkheads, and floor racks. This car was in transit from Brawley, Calif., to New York, N. Y., June 26 to July 8, 1917.

of salt and the thoroughness with which the salt is mixed with the ice. If the percentage of salt is increased, up to a certain limit, the melting temperature of the mixture is lowered. Twenty-five per cent salt and 75 per cent finely crushed ice, thoroughly mixed, melts

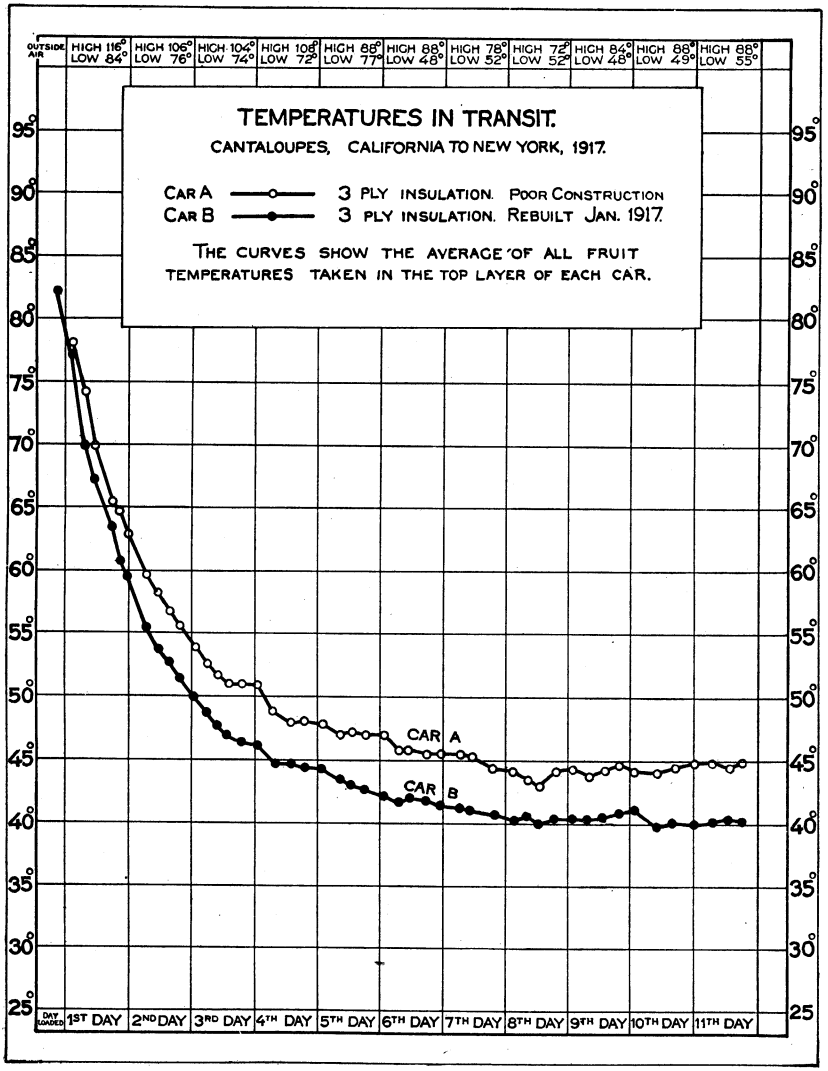



FIG. 8.—Diagram showing the average temperature of the melons in the top layers of the two cars represented in figures 5 and 6.

at about 3° or 4° below zero F. This is the lowest temperature which can be obtained with salt and ice. If still more salt is added, that is, if the mixture contains more than 25 per cent salt, the melting temperature will not be so low.

In an ice and salt mixture, the ice melts more rapidly than when ice alone is present on account of the lower temperature of the mixture. Consequently, heat is taken up more rapidly from the air and produce within the car and both are cooled to a lower temperature than is possible by the use of ice alone.

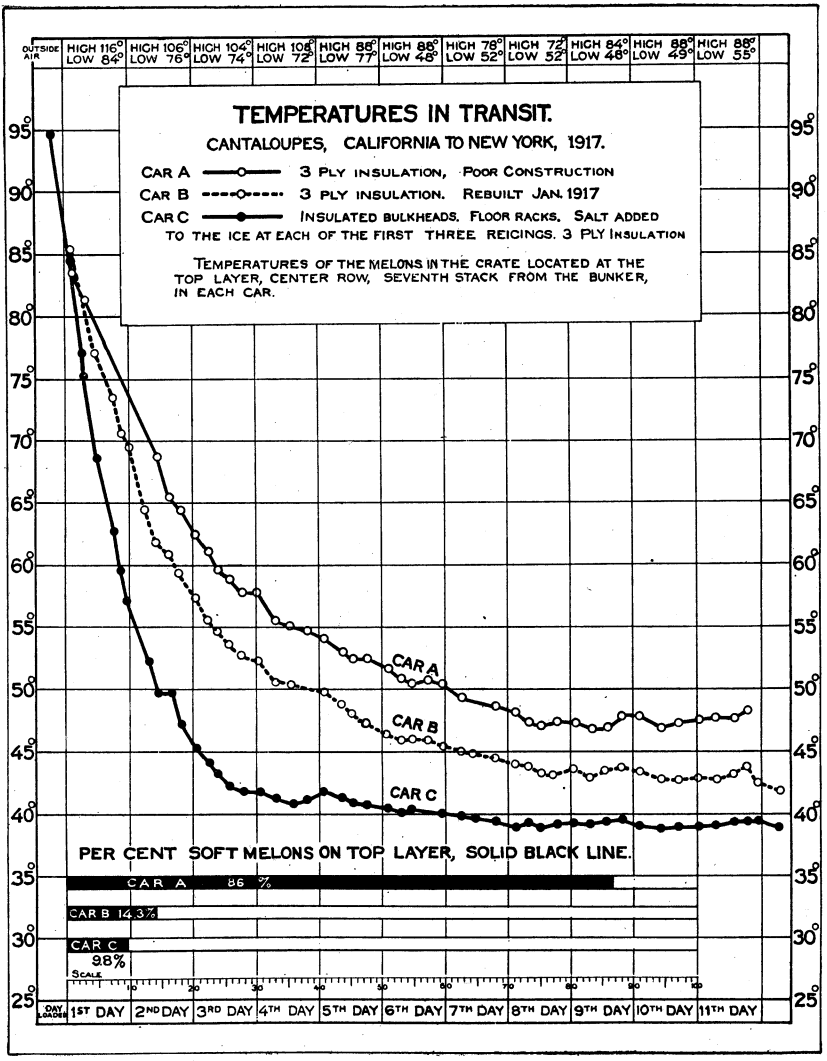



FIG. 9.—Diagram showing the warmest temperature of the melons, and the percentage of soft melons in the top layers, in the three cars represented in figures 5, 6, and 10.

Several experiments have been made to determine the additional cooling obtained by salting the ice in the bunkers of cars of cantaloupes immediately after loading. It has been determined that cooling is considerably hastened by this practice. When salt is used it should be added to the ice immediately after the car is loaded.

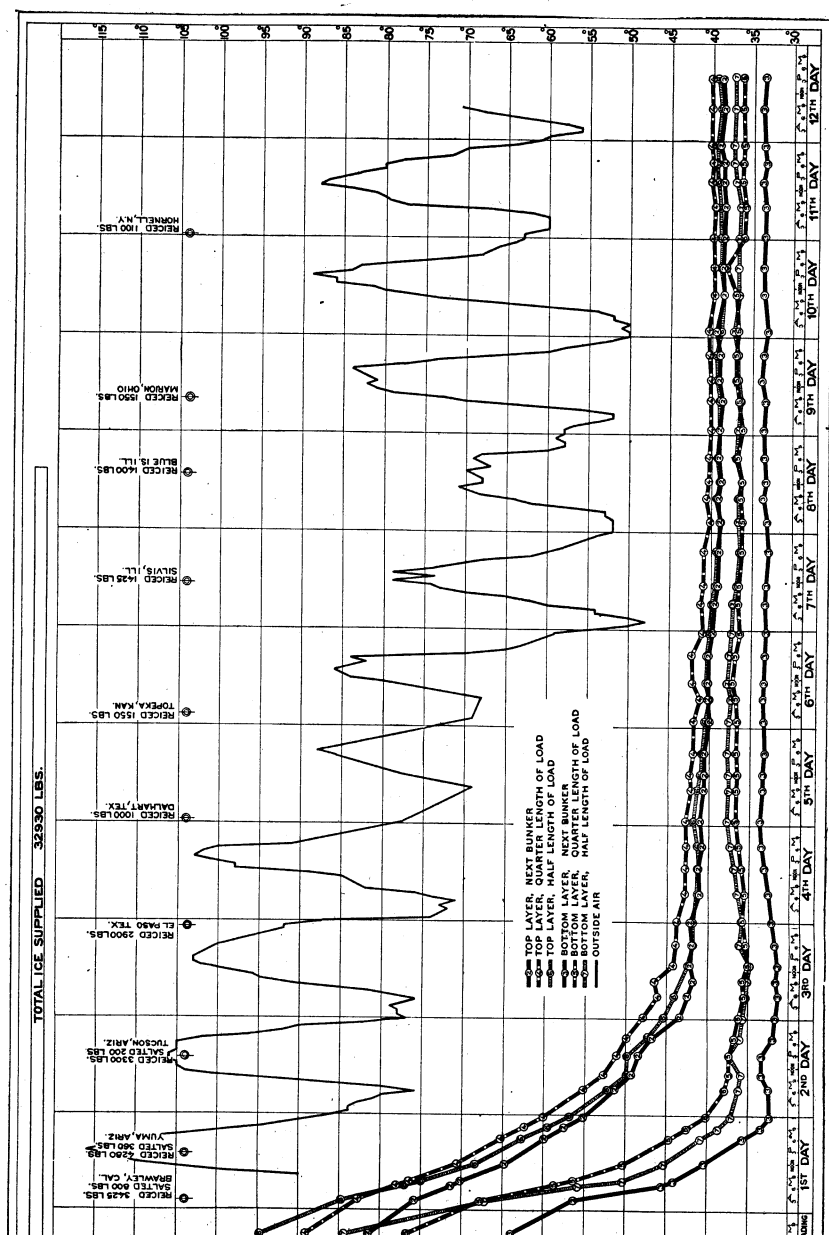


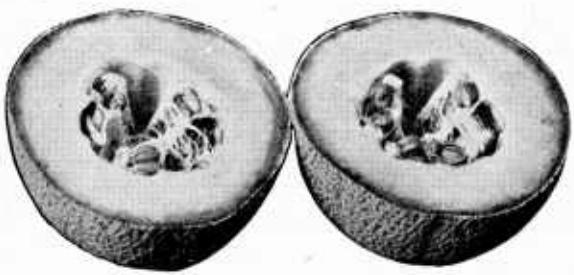

FIG. 10.—Diagram showing cantaloupe temperatures in a car equipped with basket bunkers, insulated bulkheads, and floor racks. Salt was added to the ice in this car as shown in the diagram. The car was in transit from Brawley, Calif., to New York, N. Y., June 26 to July 8, 1917.

The ice at the top of the bunker should be broken up into small pieces with an ice pick and the salt applied on top of the ice. Coarse salt, No. 2 or larger, is preferable. When the temperature of the melons is 80° F. or higher, 10 per cent of salt, approximately 500 pounds to each bunker, may be safely added at the first application. At the first icing station 100 to 150 pounds of salt may be applied to each bunker. If the temperature of the melons is below 80° F., the quantity of salt should be reduced, not more than 5 to 8 per cent being added at the first application, according to temperature conditions.

Salt should never be added to the ice except in cars equipped with floor racks, solid, insulated bunker bulkheads, and basket bunkers which provide a 2-inch air space around the ice. On account of the obstructions to air circulation in the ordinary refrigerator car, the use of salt in a car of this type merely serves to chill or freeze the melons at the floor of the car near the bulkhead without in any way hastening the cooling in the warmer portions of the load. With the improved construction already described, however, air circulation is continuous and unobstructed and there is no banking of cold air against the crates close to the bulkhead.

Figure 9 shows the top layer temperature at the bracing in a car in which salt was used (Car C) as compared with the temperature in the same location in two cars already described. This is usually the warmest portion of the load, and it will be seen that refrigeration is considerably hastened and the temperature materially lowered by the use of salt and the improved construction of Car C. It will be observed, also, that 9.8 per cent of the melons in the top layer of the latter car were considered "soft" from a marketing standpoint upon arrival at destination as compared with 86.0 in Car A, and 14.3 per cent in Car B.

Figure 10 shows the cantaloupe temperatures in transit at six positions in a car equipped with basket bunkers, insulated bulkheads, and floor racks, salt having been added as indicated, at the first three reicings after the car was loaded. The important showing in this car is the extremely rapid drop in temperature during the first 48 hours.



## PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RELATING TO THE HANDLING AND SHIPPING OF PERISHABLE FRUITS AND VEGETABLES.

DEPARTMENT BULLETINS.

Department Bulletin 601: Handling and Precooling of Florida Lettuce and Celery.
Department Bulletin 861: Marketing Eastern Grapes.

FARMERS' BULLETINS.

Farmers' Bulletin 707: Commercial Grading, Packing, and Shipping of Cantaloupes.
Farmers' Bulletin 753: Commercial Handling, Grading, and Marketing of Potatoes.
Farmers' Bulletin 1050: Handling and Loading Southern New Potatoes.
Farmers' Bulletin 1091: Protection of Potatoes from Cold in Transit—Lining and Loading Cars.
Farmers' Bulletin 1189: Handling Spinach for Long Distance Shipment.

MARKETS DOCUMENTS.

Markets Document 8: Factors in the Transportation of Strawberries from the Ozark Region.
Markets Document 13: Heavy Loading of Freight Cars in the Transportation of Northwestern Apples.
Markets Document 14: Loading American Grapes.

THE investigations of the Department of Agriculture were conducted during the shipping seasons of 1915, 1916, and 1917 in the producing sections of California, Arizona, and Colorado, and in the consuming centers of New York, Philadelphia, and Pittsburgh. The relation of the commercial practices of harvesting and preparing cantaloupes for shipment to carrying and keeping qualities in transit and distribution was studied as well as the influence of loading methods and modifications of car construction in retarding or accelerating refrigeration. Test trips were made from the Imperial Valley, Calif., Turlock, Calif, and Glendale, Ariz. In each test, the shipments under observation were loaded on the same day and the cars moved in the same train to destination. They were accompanied by representatives of the department, who at intervals, approximately five or six hours apart, secured a record of the temperature of the air and melons at 12 selected locations in each car. The observers also obtained a record of the atmospheric temperature, and, in most cases, of the actual weight of the ice supplied each car. The number of cars in each test varied from 4 to 13, the usual number being about 8.

The temperatures within the cars were obtained by specially constructed electrical thermometers. These thermometers were connected by short cables to a master cable. A small portion of the master cable, in the form of a flattened plate, passed out between the door and door frame to the roof of the car. Thus no opening was made that would permit an appreciable influx of hot air. The temperature readings were obtained from the roof of the car. By the use of this equipment, it was possible to obtain an accurate record of temperature conditions within the cars without opening the doors or ventilators at any time. It was also possible to obtain the temperature of melons in crates at the bottom of the load, and at other points where it would have been impossible to locate or read mercury thermometers.

Every effort was made to control each shipment tested, so that it differed from the others in the same test only with regard to the particular factor under investigation. This was accomplished in all cases, so far as it was possible under actual service conditions. The effects of loading methods, car construction, and refrigeration practices on the temperature of cantaloupes in transit are presented graphically in the illustrations accompanying the text.



WASHINGTON : GOVERNMENT PRINTING OFFICE : 1921